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The Formula of Hildegard von Bingen

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Hope and Hops The Formula of Hildegard von Bingen

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Abstract There is a conviction among leading beer historians that Hildegard von Bingen introduced hops as additive in beer, although there exist several skeptical voices about it. The aim of this article is to give a contribution to the elucidation of some facts in this matter. Two texts were analyzed with Perspective Text Analysis (PTA/Vertex), which captures internal relationships in texts. The first analysis concerned the widely referred translation of chapter 61 about the hop plant in *Physica* by Hildegard von Bingen. The second compared it with the Latin original. The dimensions of intention and orientation inherent in the structure point at essential differences: The translation made around the last millennium shift concentrates on *Pharmacy* in the intention and *Treatment* in the orientation, while their correspondences in the Latin original are *Gloominess* and *Brewing*. Evidently, the translation brought out by certain beer historians is a product of the spirit of time that focused on Hildegard's healing activities. In the original text, however, the focus is on making a kind of brew that had the capacity to circumvent the poor condition that was an effect of hops. [Published September 17, 840 years after Hildegard's death.]

Sibyl of the Rhine

During the High Middle Ages, Germany was the best breeding ground for mysticism in the West. Hildegard von Bingen (1098-1179), the "Rheinische Sibylle", spent almost her lifetime in a Benedictine convent and died as abbess of a monastery on the Rupertsberg. In her personality, there was an unusual mixture of managerial talent and scholarship, pietism and radical thought. Primarily, she was an ecclesiastic intellectual, who had visions that she documented in the first book, called *Scivias* ("Know the ways"). She further wrote poems and liturgical dramas, and composed innovative instrumental and choral works to accompany the liturgy. In addition, she wrote scientific works, among others about botany and medicine. Hildegard had opinions on how world leaders, popes and kings, would relate to different political and moral issues, and in her correspondence with them, she always wrote in the tone of a divinely inspired authority and in a powerful Latin prose ("in einer lateinischen Prosa von männlicher Wucht", according to Durant, 1967, Vol. XII, Chap. 12, p. 430). The clergy were grief-stricken, for these revelations strongly criticized the wealth and corruption of the Church. Through her knowledge and wisdom, she had a lot of influence upon the societal structure in which she worked.

Hildegard von Bingen has been an immensely popular historical personality for some decades and was celebrated as a saint for a long time before she was finally canonized in 2012. Her music is widely performed in concert halls and churches. Her health recipes, based on spices and herbs, which have been tested and appreciated anew, have become up-to-date as well as her spirituality-based lifestyle advice. The texts for which Hildegard von Bingen is best known today are *Physica Sacra* (or just *Physica*) and *Causae et Curae*, which are two parts of a work about nature and its healing powers.

A Text with cult status

Hildegard von Bingen had considerable botanical knowledge. Therefore, beer lovers have recently paid attention to her writings of hops. It is because the antibacterial and preservative properties of the hop plant have been crucial for the increased prosperity of her future generations (I. Bierschenk, 2019). Hop flowers as a constituent of beer have contributed to the new interest in Hildegard from beer historians and other interested parties. The text commonly referred to when it concerns how hops is acting in beer is found in *Physica*, the First book, chapter 61, which is named *De Hoppo* (or *Hoppo*). Because of the interest noted for the text, often reproduced in an English translation from *A short history of hops* (Cornell, 2009), this study will analyse the structural depth of the text. Interesting will be to see which relationships appear in the text that beer-enthusiasts mention as example of the role of hops in beer and hence the role of Hildegard von Bingen in beer history. The question to be answered is whether there is a structural justification for using this text in claiming that it does describe the effects of the hops in beer.

It [The hop plant] is warm and dry, and has a moderate moisture, and is not very useful in benefiting man, because it makes melancholy grow in man and makes the soul of man sad, and weighs down his inner organs. But yet as a result of its own bitterness it keeps some putrefactions from drinks, to which it may be added, so that they may last so much longer. [quote from Cornell, 2009¹]

¹ Martyn Cornell has communicated (2018-09-24, 18:58) that the translation from original Latin was made by a specialist in Latin translation who was actually a languages teacher at a private school and that it was 16 or 17 years ago.

Perspective Text Analysis

Perspective Text Analysis (PTA/Vertex) is designed to access something invisible, as a structure or intention (B. Bierschenk, 1993/2013, 2011; I. Bierschenk, 1999/2003; 2011; I. Bierschenk & B. Bierschenk, 2011). A PTA/Vertex analysis detects the internal dynamics of a text, which does not have a direct visual link to the surface. The analysis establishes a protocol of how strings of graphemes are manifested and interwoven in the text building. Thereby it uncovers the mechanism that generates disparities in the flow and determines what the gaps should be filled with for the texture to be complete. The material components of the first step are Agent and Objective. These two twine themselves together in the textual movements (flow) but the technique tears them apart and makes possible to study them separately without their interdependency being lost.

In the next step, a fusion of grapheme strings takes place based on distance to create concentrations (state attractors) of information. These attractors together form a network, presented as a geometric landscape and given empirical names, which thus are the results of transformations that take place exclusively based on the asymmetrical collaboration of physical and virtual strings. The components of the information concentration, which are immaterial, are Intention and Orientation. After the orientation network has been established, the intention can be extracted from it. These immaterial dimensions will be the essential ones to this analysis. However, since the flow dynamics is the methodological starting point, the reporting of results begins with the graphical representation of Agent and Objective in Figure 1. Only a short comment to these graphs will be given.

For the graph presentation, SigmaPlot (2014, version 13.0) was used. The program converts data to a scale and searches for the best way to present the result. The loading of data has been made from the left as in normal reading, so the reading of the graphs should begin from the lower right corner instead. The graphs show the full extent of each component

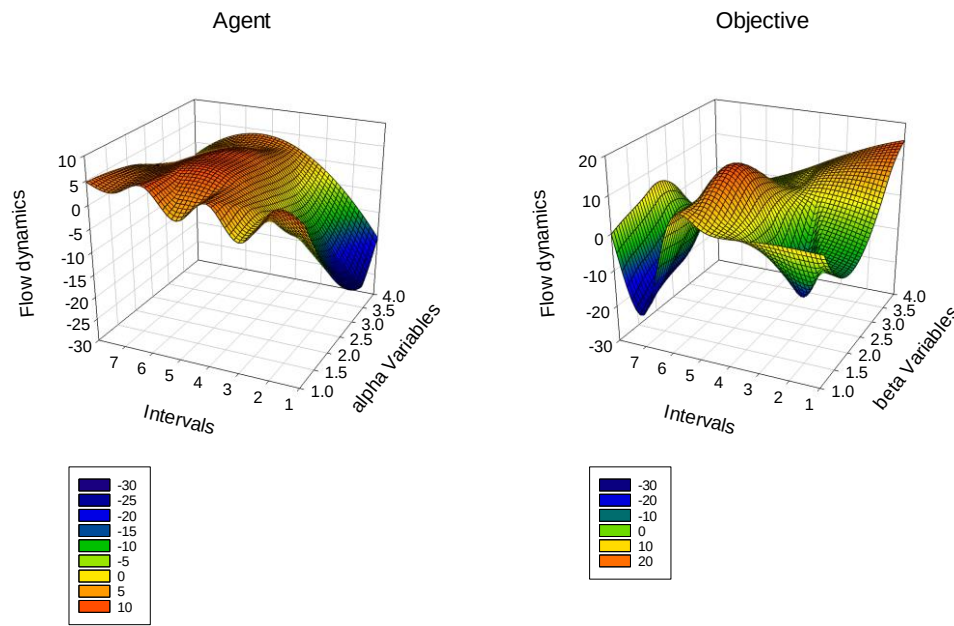


Figure 1 *Hildegard von Bingen (translation): Flow dynamics*

The flows show a clear complementarity between Agent and Objective. Even more clearly, the deep and flat parties reflect this complementary relationship. The depth of the Agent appears in the beginning, while the depth of the Objective appears in a marked way at the end. The deepest place in the Agent occurs in the third interval, while the depth of the Objective is in the seventh. In addition, they show greater diversity in dimensionality. The Agent extends a lot in space, a condition indicating that the text is subjectively controlled, i.e., the intention is apparent through its great depth.

Hildegard von Bingen (translation): Orientation

Figure 2 presents the orientation dimension in the Hildegard translation (see entire fusion process in Appendix, Table A1). The shape is forming a ring structure, which means that the values of the groupings do not follow in serial. There are three principles to choose for describing the concentrations in the landscape: following the groupings of the regions, or clarifying the procedure. Deciding on a procedural description means that either a deduction of the transformations takes place, which is a description from the top, or an induction takes place, which is a description from the bottom to substantiate the premises of the result. The PTA/Vertex method is highly precise, which means that the reasoning about the relationship of the attractors should be deductive. However, because their meaning has come about empirically and therefore has not been semantically predetermined, the inductive way of presenting the result is the choice here.

Poor condition (strain=8, shear=4) is the name of the attractor that summarizes the different states, in which a person may be bodily and spiritually and which weakens her ability to recover from illness. Partly, this condition is due to the additives made to the water, in this case hops, which produce unwanted outcomes. Side effects like melancholy and sentimentality are ineffective states of mind and when the state of mind has turned weak, it gives the same effect to the state of the body.

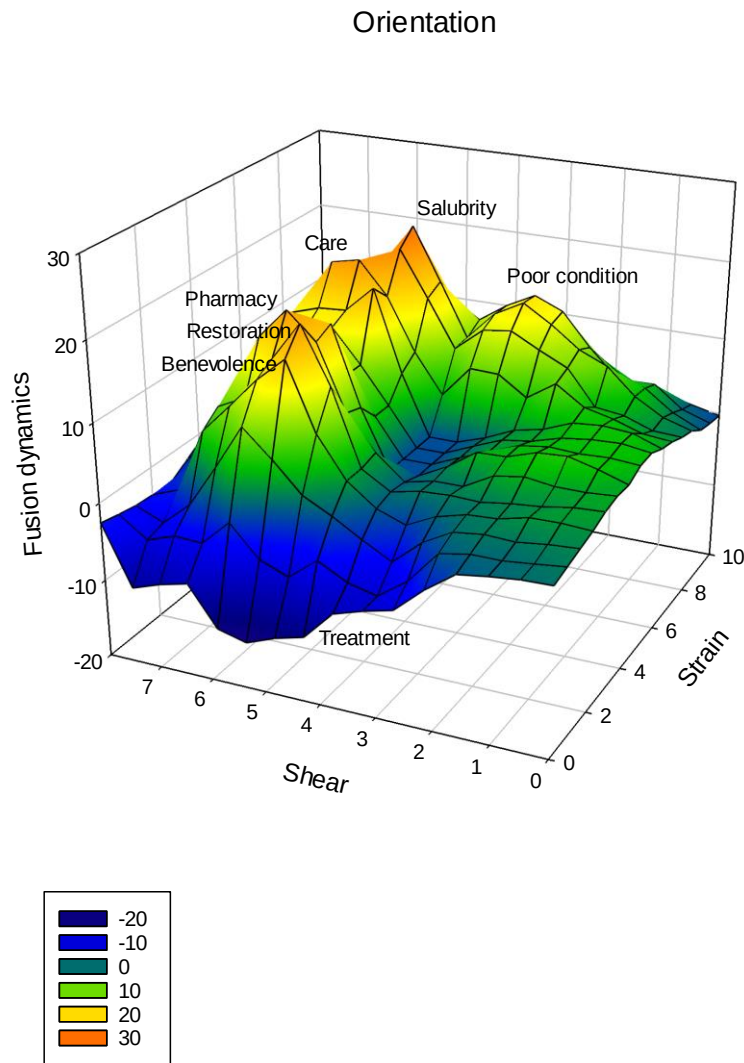


Figure 2 Hildegard von Bingen (translation): Orientation

The discovery that hops have a preservative effect is positive for the quality of it as a drink. The preservation through the addition of hop flowers brought to boil for a long time becomes the turning point that rebuilds the weak state of both a person and the drink itself. This is reproduced in the structure through *Restoration* (strain=8, shear=6).

It was a slight revolution when food and drink could last for a long time. Therefore, the addition of hops to brewing different beverages has a health promoting result. The beverage that Hildegard has brought to the fore by her experimentation has such qualities that it contributes to prosperity. It is expressed in the term *Salubrity* (strain 7, shear=6). Here Hildegard's personal involvement comes into view.

Hildegard was a botanist who made experiments with plants that she imagined had some influence on human well-being. This experimental approach includes making forecasts of what the different steps in a process may entail. She wanted to do well in terms of prescripts and her *Care* (strain=5, shear=6) probably included medical conceptions and the kind of care that takes place in the medical environment.

Various attempts to test and transmit mixtures of fluids and herbs have been the task of especially women in different cultures for a long period. A mixture consisting of a certain saturation of hops resulted in a drink that had health effects and became almost a drug when

they could produce it on a larger scale, for example in the monasteries / nunneries. Therefore, it is quite natural that the term *Pharmacy* (strain=3, shear=6) appears in connection with *Care*. The production should have been extensive given Hildegard's extensive network of papal, royal and noble customers.

In the world where the nunneries took responsibility for protecting people's bodies and souls, the ointments and blends that the nuns served to the sick and needy were not always so beneficial. Thus, *Benevolence* (strain=2, shear=6) relates to Hildegard's acknowledgment that the mission she considered she had and which she performed of charity could have negative side effects. The effects of hops were not always so positive for the soul.

The additive to the drink, the active substance, commonly known as the agent, entered a symbiosis of the nun's and the nunnery's intentions to perform charity and eventually became akin to medical treatment. *Treatment* (strain=2, shear=4) is the last and most integrated state of attraction and it is placed deep in the structure, indicating the basic theme of the orientation.

Hildegard von Bingen (translation): Intention

Figure 3 presents the intention in the Hildegard translation (for the extraction procedure, see Appendix, Table A2). The intention landscape shows a shape that corresponds to the orientation landscape. It has a compressed shape but is dynamic and well profiled.

It is clear that this structure is presenting specific concepts that link to the effects of hops in the individual situation. *Pharmacy*, *Care* and *Salubrity* are returning concepts, which underlines their overall importance. However, in the intention, the relationship between them is a bit different, as *Pharmacy* is getting higher significance here than in the orientation. New in the intention are *Affection*, *Preservation*, *Ineffective* and *Serving*, emanating from substructures and thus having an underpinning role.

Pharmacy places itself at the top, followed by *Care* at a somewhat lower altitude but in the same region. Both emphasize that the intention is that the nunnery's productivity should concern the manufacture of drugs and a willingness to practice the art of healing.

Affection and *Preservation* are close to each other in another region. *Affection* is the summative concept of Hildegard's unwanted state of mind, which she, among other things, calls melancholy, because of hops. *Preserving* on the other hand is the outcome of hops that have a positive effect on the drink itself to make it resistant to bacteria. For example, she recommended always boiling the water.

The experience that the treatment is not so well functioning is evident by the terms *Ineffective* and *Serving*. *Ineffective* refers to the characteristics of the hop plant, especially when it comes to dose it properly. *Serving* in this context means, concretely, to give someone a drink, which turns out to have undesirable results. Both are deep in the structure, thus confirming the theme of treatment and its consequences.

Salubrity forms its own group, which represents the combination of restoration of different dysfunctions and the possibility of storing beverages for longer time, in short, a successful botanical discovery, namely the healthy properties of beer thanks to hops.

Overall, one can say that the English translation of Hildegard von Bingen's article on hops treats the pharmaceutical aspect of hops use. It is understandable that this text has a special status for the beer historians, who think that hopped beer is healthy. A place in the beer history has the text undeniably. However, how does the text relate to the Latin original when investigated by the same method? Next section will answer that question.

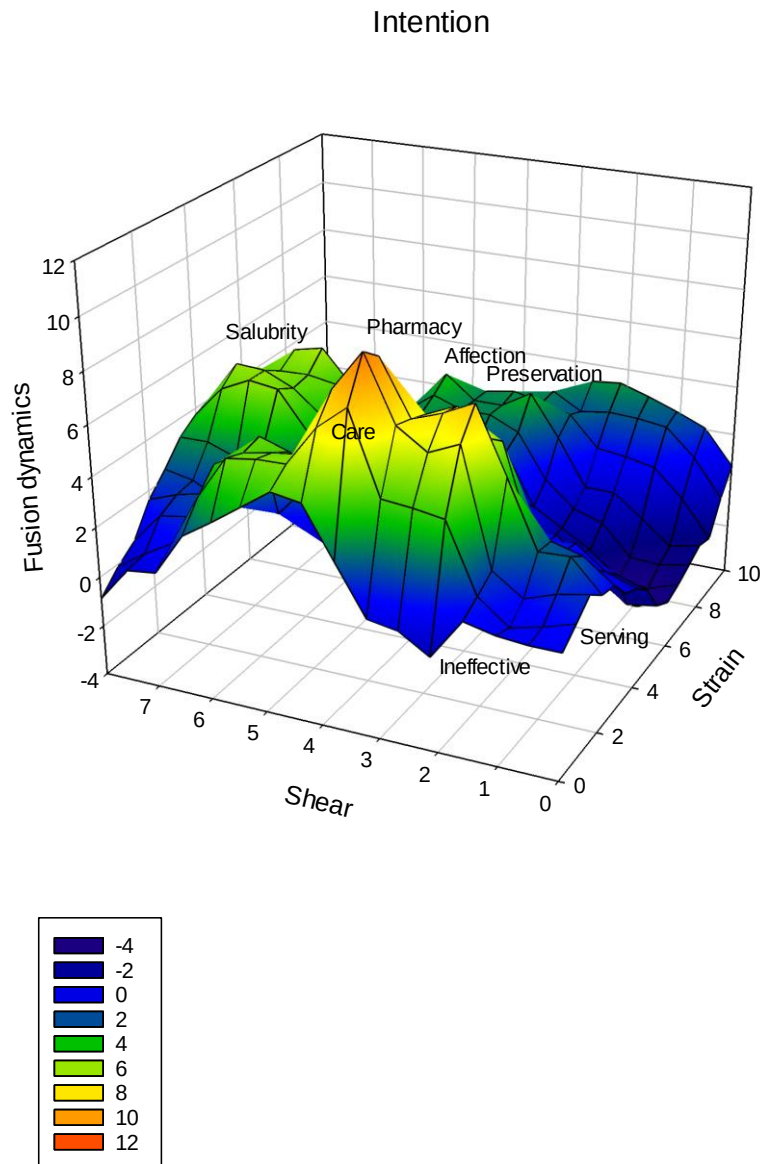


Figure 3 Hildegard von Bingen (translation): *Intention*

What does Hildegard in fact say about hops?

The Latin original text is not accessible, mainly because copies available are transcriptions from later date. There are two manuscripts from around 1300 in Wolfenbüttel and Florence, and two others from the 1400s in Paris and the Vatican. Further processed documents are available in Brussels, Strassburg and Freiburg. The text reproduced here is a commented version, published in Germany by R. Hildebrandt and T. Gloning (Bingen von, 1151-1158 / 2010):

Hoppo / (Humulus) calidus et aridus est, et modicum humiditatis habet, **2** atque ad utilitatem hominis non multum utilis est, quia melancoliam in homine crescere facit, et mentem hominis tristem parat, et viscera eius gravat ariditate sua, **3** *quoniam cum humores in homine arefacit, cum tristem reddit arque gravat.* **4** Sed tamen in amaritudine sua quasdam putredines de potibus prohibet ad quos additur, ita quod tanto diutius durare possunt. (p. 91)

[Printed on 9/6/2018, 10:17 AM via Malmö University e-book collection]

The italicized sentence is not included in the analysis, as it does not belong to the scanned translations of the text available on the internet (clerus.org and monumenta.ch.).

The analysis begins again with the flow dynamics, which Figure 4 displays.

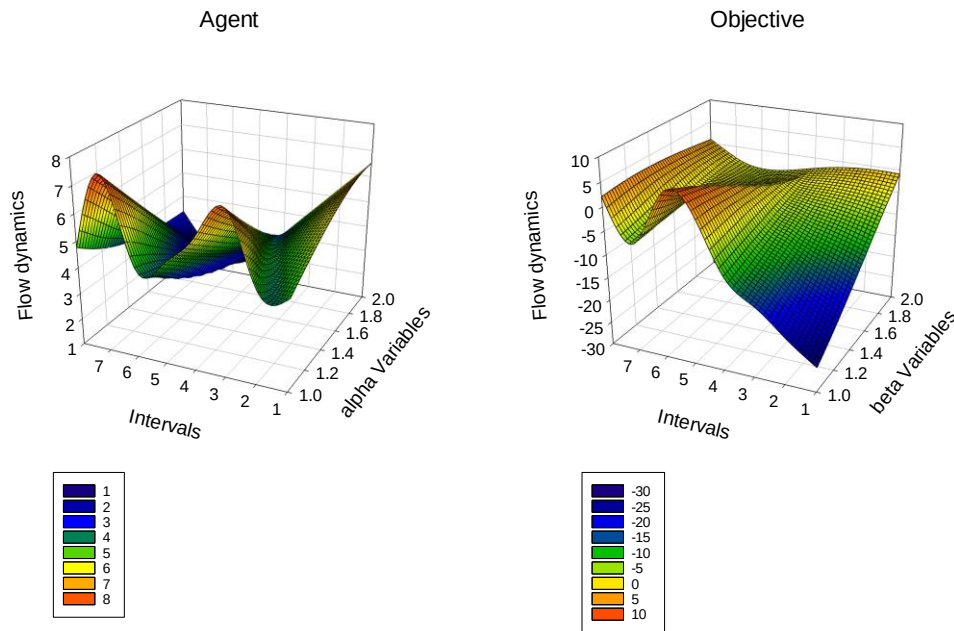


Figure 4 Hildegard von Bingen (original): Flow dynamics

As is probably known, in a Latin sentence, inflection governs the identification of subject and object and not primarily their position in relation to the predicate verb. A Vertex-analysis builds on the condition that the A-position means before the verb and the O-position means after the verb, independent of semantic interpretation, since the Agent component is not the same as grammatical subject or agent (I. Bierschenk, 2011).

An example of the consistency of the fixed positions is the first sentence, *Hoppo calidus et aridus est* (Ø), which has a long composite Agent followed by the verb (*est*), which, on the other hand, lacks Objective, leaving an empty position. It takes its root values from the next clause. This means, especially in the Latin, that the information that will fill the empty channels is not fully clear-cut until the entire text is complete, which is evident from Table B1 in Appendix. The combination of empty positions on both the A and O sides produces a very dynamic flow. This also applies to the kind of Latin that Tacitus wrote (I. Bierschenk, 2012).

The flow has a very distinct complementarity. The Agent forms powerful wave movements, where the shifts between shallow and deep give the character. However, the oscillations stay above the zero line. The Objective forms a large depth at the beginning and then goes on with a large wave and finally it is levelling out. The lowest values of the Agent appear in the fourth and seventh intervals, while the highest values appear in the seventh and the first interval respectively. The lowest values of the Objective occur in the first three intervals, while the highest value occurs in the sixth interval.

The complementary relationship between A and O, illustrated by the technique of separating them, applies to every genuinely evolved text. Other studies with PTA/Vertex have shown that this complementarity also applies to translations between languages, but then expresses itself in a diametrical relationship (B. Bierschenk, 2001, 2002). The Latin text and the translation are examples of the diametrical relationship; in the Latin, the Agent is more dynamic, while in the translation the Objective is more dynamic.

Hildegard von Bingen (original): Orientation

Figure 5 shows the landscape formation of the orientation (see Appendix, Table B1). The landscape displays a broken surface with a concentration to a high plateau where two attractors collect, namely *Hope* and *Ingestion*. Most concentrations lie in some sharp profiled ravines, indicating that *Brewing*, *Admixture*, *Saturation*, *Hallucination* and *Delusion* belong to the deep structure. The path to get there is quite bumpy.

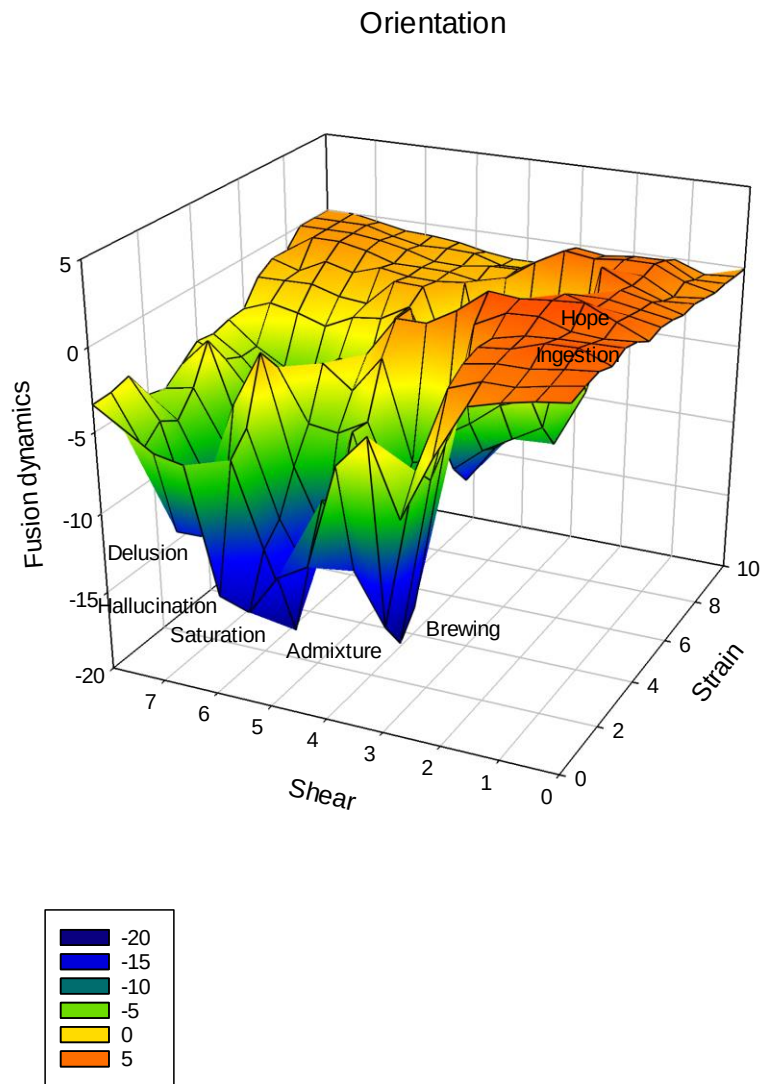


Figure 5 Hildegard von Bingen (original): Orientation

Ingestion (strain=5, shear=2) stands here for the taking of a drink to cure a state of weakness and ill health. It assumes that the drinker can trust that the fluid is not putrid but contains an ingredient that keeps it fresh. This ingredient counteracts a dissolution state and contributes to preservation.

Ingestion relates not only to actual substances but also to an idea of their healing power. The desire to influence a health condition in the right direction is due to both botanical and spiritual experiences. That the addition of hops increases the disposition of "black bile" causes

at the same time the nervous system to be relaxed, because the sleep improves. This discovery gives *Hope* (strain=8, shear=2) to the solution of several physiological health problems.

The hope of a health drink has its foundation in the underlying structure that shall now be unveiled. Regardless of what you want to call an unhealthy state, the body and soul is in a state of disorder that you need to restore and prevent from decay. *Delusion* (strain=4, shear=6) accounts for the negative impact or misfortune it implies when a medically motivated desire to restore gets the opposite effect, that is, the good hop drink makes the drinker gloomy instead of strong.

Gloominess is a sign that the drinking person becomes relaxed and drowsy or perhaps a little drunk, which during this time and within the walls of the nunnery can very well lead to the "patient" losing the footstool to reality and the imbalance becoming mental when visions are common. The term *Hallucination* (strain=2, shear=6) says that gloominess in combination with delusion crosses the line.

The drink, which produces these unwanted effects, is thus not very beneficial from the beginning. Rather the opposite; it is unfavourable. This states that hallucinations and similar conditions must be prevented, which means that the person experimenting with her botanical skills needs to achieve such a degree of *Saturation* (strain=2, shear=5) with regard to the dosage of active hops that its effect is optimized. The core of the structure and the discovered healing beverage is the term *Admixture* (strain=2, shear=4). It appears at the lowest level and represents the local minimum value in the structure. Admixture is the transformation of Saturation and the degree of moisture, which only through careful measurement and evaluation can achieve an optimum blend.

Once this admixture has been established and combined with the Hope of the experimenter (botanist) for a resulting cure, the final attractor evolves in the form of the concept *Brewing* (strain=6, shear=3). Brewing stands for the empirical work that Hildegard and her convent sisters performed in service of the public, which led to the discovery that hops were not only a flavoring and preservative ingredient but also contained beneficial properties.

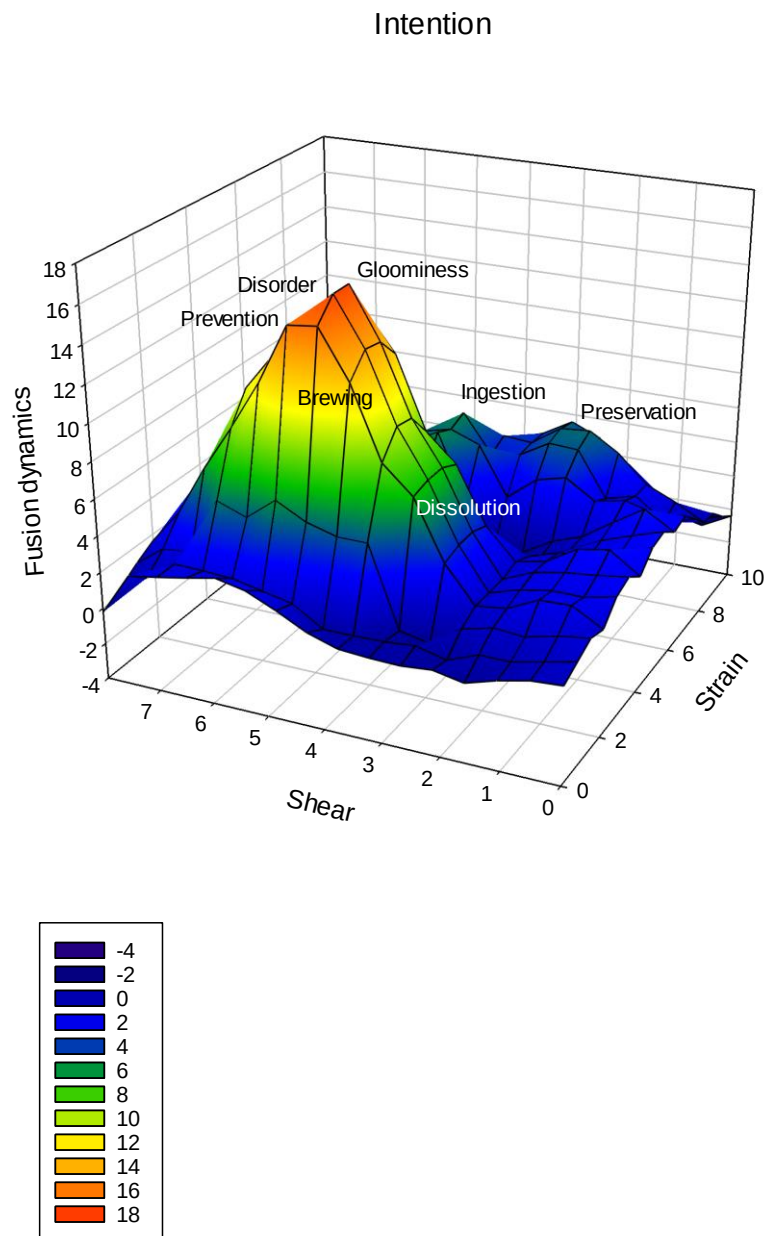
Hildegard von Bingen (original): Intention

Figure 6 shows the landscape formation of the intention (see Appendix, Table B2) The most focused concepts in the intention are *Melancholy* and *Disorder*, which relate to symptoms that have to do with the side effects of the intake of the mixture. Disorder is an aspect of the orientational concept of *Delusion*, which together with *Gloominess* is an aspect of *Hallucination*. *Prevention* relates to the actual addition of hops to the water, which is a necessary measure to counter these side effects.

A second group consists of *Ingestion* and *Preservation*, which relate to the potential of the fluid, because *Preservation* counteracts the weakening of the organs and enables the consumption of the drink for a long time. *Dissolution* is the concrete event that is the reason for the actions, namely the risk of, for example, dehydration.

One concept has its place without a clear relation to another group, namely *Brewing*. Brewing is the result of the botanical knowledge and the hope as a spur of achieving some charity, i.e., the concept of an activity. It is the most integrated concept in the orientation and returns in the intention, although with relatively lower value.

The asymmetry observed in the flow dynamics is also present in the fusion dynamics. The three mental concepts Hope, Delusion and Hallucination have not shown up in the intention, nor have the operational Saturation and Admixture. New in the intention are instead Gloominess, Disorder and Prevention, which indicate that the worrying state of ill health lies in the perspective. *Brewing* and *Ingestion* are the only ones found in both orientation and intention. The conclusion should be that the nature of the hops is not the primary aspect in Hildegard's article but its usefulness.



Figur 6 Hildegard von Bingen (original): Intention

Summary

This study has examined two texts linked to hop additive in beer using Perspective Text Analysis (PTA/Vertex), which captures textual inherent structural relationships. The following overview summarizes the structure of the two texts through their most integrated concepts of the intention and orientation:

<i>Text</i>	<i>Intention</i>	<i>Orientation</i>
English translation	Pharmacy	Treatment
Original Latin	Gloominess	Brewing

The two Hildegard texts treat a relatively narrow side of the import of hops in the history of beer. In the English translation, the theme of the orientation expresses a specific aspect through *Treatment*, while the intention refers to the entire area by *Pharmacy*, which includes this treatment. The concept pair articulates the idea of the nuns as care-giving botanists and healing professionals, whose orientation is to develop treatments for various disorders, which they base in pharmaceutical trials, resulting in the manufacture of medication.

As expected, the word pair of the original text is similar to the translation, because the theme indicates an activity, although Brewing is more concrete than Treatment. In the intention, *Gloominess* appears, which is the cause of the business and relates to the human aspect, the recipient, and not to the means. The text gives Hildegard's own idea of what she is doing and why. She is not talking primarily about her treatment recipes or her medical knowledge. In her motivation is the operational, expressed in the actual brewing of something to ingest. The focus is to counteract a low mental state, which makes you a little out of balance, what she calls melancholy in line with the *Zeitgeist* of her time.

Discussion

It is interesting to note that nowhere in the texts that inform about Hildegard von Bingen is it explicit that she made an effort in the history of beer. Nevertheless, there is a general conviction that Hildegard did start brewing beer with the addition of hops. The article *Women in Brewing* (Wikipedia, 2018) makes this clear through the information that Germanic women brew their "meads and ales" without hops, "which was first recommended as an additive by St. Hildegard of Bingen".

However, it seems that she was not first with this recommendation. The first confident textual proof for the use of hops in beer is from the year 822 through the French Benedictine abbot Adalhart / Adalard of Corbie (Karlsson Strese, & Tollin, 2008). Not until the end of the 1100s, when Hildegard mentioned the uses of hops, this was widely spread through her texts. As far as is known, Adalbert did not spread any writings outside the French monastery.

Among the beer historians and beer enthusiasts, there are different views on whether Hildegard does talk about beer in the quoted "cult text". The word she uses, according to the translator, is drinks. There are voices that claim that drinks cannot mean beer (Lat. *potibus* means beverages). Others are more convinced (e.g. Mangelsdorf, 2017; Mousson, 2018). Cornell argues for the beer theory by giving examples of other places from Hildegard's works where she unequivocally speaks of beer. He explains that Hildegard knew the effects of hops in beer, for example: "If you also wish to make beer from oats without hops, but just with grusz [gruit], you should boil it after adding a very large number of ash leaves ..." (Cornell, 2009).

The Latin original also does not provide evidence that there is talk of beer in the article about hops. Why, then, is it so important that Hildegard's name is associated with the hops additive in beer? The answer is probably in the outcome of this study. The primary interest area for the beer historians who are active today is the issue of beer production with hops. The translation of the hops text shows that the perspective (to which the translator itself contributes, though inadvertently) is overreached. It appears that the translation (made about 16-17 years ago, as reported by Martyn Cornell) took place during the hype-like interest for Hildegard von Bingen and her natural medicine healing philosophy at that time. A first translation of the entire *Physica* had just arrived (1998) in the translation of Priscilla Throop. The beer enthusiasts simply needed a cult figure in which they could hang up their hops interest. For those who think that Hildegard von Bingen should be remembered for her discovery of the health effects of hops, exploited by various organizations such as Healthy Hildegard (2018), the analysis of the "cult text" is clearly supportive.

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Accepted September 17, 2019

Appendix

Table A1: English translation

Transformation of β -variables from the O-mesh

<i>X</i>	<i>Y</i>	<i>Node</i>	<i>Value</i>	<i>Transformation</i>
0	1	D	0	
1	0	1	4.7728	is warm and dry
1	1	T₁	4.7728	Hops ingredient
2	0	D	0	
3	0	2	5024	has a moderate moisture
3	1	T₂	5.024	Consistency
1	1	T ₁	4.7728	Hops ingredient
3	1	T ₂	5024	Consistency
3	2	T₃	9.7968	Recipe
4	0	3	4.8670	is not very useful
5	0	5	4.1762	benefiting man
5	1	T₄	9.0432	Ineffective
3	2	T ₃	9.7968	Recipe
5	1	T ₄	18.84	Ineffective
5	2	T₅	18.84	Unproductive
6	0	6	4.239	makes melancholy
7	0	7	5.3793	grow in man
7	1	T₆	9.6183	Gloomy
10	1	8	4.4588	makes the soul
10	2	9	5.3406	of a man sad
9	2	T₇	9.7994	Sentimental
7	1	T ₆	9.6183	Gloomy
9	2	T ₇	9.7994	Sentimental
8	2	T₈	19.4177	Affection
5	2	T ₅	18.84	Unproductive
8	2	T ₈	19.4177	Affection
8	3	T₉	38.2577	Side effect
10	3	D	0	
10	4	10	5.809	weights down his inner organs
9	4	T₁₀	5.809	Weakening
8	3	T ₉	38.2577	Side effect
9	4	T ₁₀	5.809	Weakening
8	4	T₁₁	44.0667	Poor condition
10	5	11	4.7728	keeps some putrefactions
10	6	12	4.9923	from drinks
9	6	T₁₂	9.7651	Preservation
8	4	T ₁₁	44.0667	Poor condition
9	6	T ₁₂	9.7651	Preservation
8	6	T₁₃	53.8318	Restoration
8	8	D	0	
8	7	17	5.3406	last so much longer
7	7	T₁₄	5.3406	Long-lasting
8	6	T ₁₃	53.8318	Restoration
7	7	T ₁₄	5.3406	Long-lasting
7	6	T₁₅	59.0756	Salubrity
8	8	D	0	
8	7	16	-0.09302	may(so that they+(to which it...+last so much longer)
5	7	T₁₆	-0.09302	Prognostication
7	5	T ₁₅	59.0756	Salubrity

5	7	T_{16}	-0.09302	<i>Prognostication</i>
5	6	T_{17}	58.98258	Care
8	4	D	0	
8	3	15	-4.98831	added (to which it+so that they+may...+last so much longer)
3	7	T_{18}	-4.98831	Admixture
5	6	T_{17}	58.98258	<i>Care</i>
3	7	T_{18}	-4.98831	<i>Admixture</i>
3	6	T_{19}	53.99427	Pharmacy
2	8	D	0	
1	8	4	-11.6395	in (, and+benefiting man)
1	7	T_{20}	-11.6395	Serving
3	6	T_{19}	53.99427	<i>Pharmacy</i>
1	7	T_{20}	-11.6395	<i>Serving</i>
2	6	T_{21}	42.35477	Benevolence
0	7	D	0	
0	6	14	-13.9397	be (, to which it+added+so that they+may+...+last so much longer)
1	6	T_{22}	-13.9397	Agent
2	6	T_{21}	42.35477	<i>Benevolence</i>
1	6	T_{22}	-13.9397	<i>Agent</i>
2	5	T_{23}	28.41507	Medication
0	5	D	0	
0	4	13	-20.8335	may (to which it+to which it+be (...))
1	4	T_{24}	-20.8335	Brewing
2	5	T_{23}	28.41507	<i>Medication</i>
1	4	T_{24}	-20.8335	<i>Brewing</i>
2	4	T_{25}	7.58157	Treatment

Table A2: English translation*Extraction of terms from the O-mesh*

<i>X</i>	<i>Y</i>	<i>A-component</i>	<i>O-component</i>	<i>English term</i>	<i>Fusion</i>
		<i>Pendulum</i>	<i>Destination</i>	<i>Extract</i>	<i>Value</i>
1	1	$T_1: D \rightarrow 1$	T_{O1}	Hops ingredient	3.5168
3	1	$T_2: D \rightarrow 2$	T_{O2}	Consistency	4.944687
3	2	$T_3: T_{A2} \rightarrow T_{A1}$	T_{O3}	Recipe	8.461487
5	1	$T_4: 3 \rightarrow 4$	T_{O20}	Serving	-4.3073
7	1	$T_5: T_{A4} \rightarrow T_{A3}$	T_{O5}	Unproductive	4.154187
7	1	$T_6: D \rightarrow 5$	T_{O4}	Ineffective	-6.0852
7	3	$T_7: T_{A6} \rightarrow T_{A5}$	T_{O9}	Side effect	-1.931013
10	2	$T_8: 6 \rightarrow 7$	T_{O6}	Gloomy	7.8371
10	4	$T_9: 8 \rightarrow 9$	T_{O7}	Sentimental	3.6218
8	4	$T_{10}: T_{A9} \rightarrow T_{A8}$	T_{O8}	Affection	11.4589
7	4	$T_{11}: T_{A10} \rightarrow T_{A7}$	T_{O8}	Affection	9.52887
10	6	$T_{12}: D \rightarrow 10$	T_{O10}	Weakening	-0.0771
7	6	$T_{13}: T_{A12} \rightarrow T_{A11}$	T_{O13}	Restoration	9.450787
5	8	$T_{14}: 11 \rightarrow 12$	T_{O12}	Long-lasting	11.092
5	6	$T_{15}: T_{A14} \rightarrow T_{A13}$	T_{O15}	Salubrity	20.547787
3	8	$T_{16}: 13 \rightarrow 14$	T_{O22}	Agent	7.1585
1	8	$T_{17}: D \rightarrow 15$	T_{O18}	Admixture	1.2733
1	6	$T_{18}: T_{A17} \rightarrow T_{A16}$	T_{O16}	Prognostication	8.4318
1	5	$T_{19}: T_{A18} \rightarrow T_{A15}$	T_{O17}	Care	28.974587
1	2	$T_{20}: 16 \rightarrow 17$	T_{O14}	Long-lasting	8.0639
2	3	$T_{21}: T_{A20} \rightarrow T_{A19}$	T_{O19}	Pharmacy	37.038487

Table B1: Original Latin*Transformation of β -variables from the O-mesh*

<i>X</i>	<i>Y</i>	<i>Node</i>	<i>Value</i>	<i>Transformation</i>
0	1	D	0	
1	0	1	4.45566	gravat ariditate sua.
1	1	T₁	4.45566	Dryness
2	0	D	0	
3	0	6	2.3917	parat (, et viscera eius+gravat ariditate sua.)
3	1	T₂	2.3917	Weakening
1	1	T ₁	4.45566	Dryness.
3	1	T ₂	2.3917	Weakening
3	2	T₃	6.8483	Dissolution
4	0	D	0	
5	0	10	2.082958	durare (, ita quod tanto diutius+possunt (Y).
5	1	T₄	2.082958	Preservation
3	2	T ₃	6.8483	Dissolution
5	1	T ₄	2.082958	Preserving
5	2	T₅	8.9313	Ingestion
6	0	D	0	
7	0	11	0.8792	possunt+(Y).
7	1	T₆	0.8792	Possibility
5	2	T ₅	8.9313	Ingestion
7	1	T ₆	0.8792	Possibility
8	2	T₇	9.8105	Hope
10	1	D		
10	2	5	-2.36603	facit (, et mentem hominis tristem+parat+ (, et viscera eius+gravat ariditate sua.)
9	3	T₈	-2.36603	Depression
10	4	D	0	
10	5	9	-2.67012	additur (, ita quod tanto diutius+durare+(...)+possunt (Y).
9	5	T₉	-2.67012	Beneficial
9	3	T ₈	-2.36603	Depression
9	5	T ₉	-2.67012	Beneficial
7	5	T₁₀	-5.03615	Healing
8	7	D	0	
8	6	8	-6.6152	prohibit (ad quos+additur (, ita quod tanto diutius+durare+ (...)+possunt (Y).
6	7	T₁₁	-6.6152	Prevention
7	5	T ₁₀	-5.03615	Healing
6	7	T ₁₁	-6.6152	Prevention
5	6	T₁₂	-11.65135	Restoration
5	8	D	0	
4	8	4	-9.7013	crescere (quia melancholia in homine+facit (, et mentem hominis tristem+parat (, et viscera eius+gravat ariditate sua.)
4	7	T₁₃	-9.7013	Disorder
5	6	T ₁₂	-11.65135	Restoration
4	7	T ₁₃	-9.7013	Disorder
4	6	T₁₄	-21.35265	Delusion
8	2	D	0	
8	1	3	-14.7183	est (quia melancholia in homine+crescere+(quia...+facit (et mentem...+parat (, et viscera...+gravat...)
1	7	T₁₅	-14.7183	Gloominess
4	6	T ₁₄	-21.35265	Delusion
1	7	T ₁₅	-14.7183	Gloominess

2	6	T ₁₆	-36.07095	Hallucination
0	7	D	0	
0	6	2	-19.9502	habet (, atque ad utilitatem hominis non multum utilis+est+(quia+crescere+(quia+facit (et mentem... +parat (, et viscera+gravat...))
1	6	T ₁₇	-19.9502	Unfavourable
2	6	T ₁₆	-36.07095	<i>Hallucination</i>
1	6	T ₁₇	-19.9502	<i>Unfavourable</i>
2	5	T ₁₈	-56.02115	Saturation
0	5	D	0	
0	4	1	-24.6398	est (, et modicum humiditatis+habet+(atque ad utilitatem ...+est+(quia+crescere+(quia+facit (et mentem ... +parat (, et viscera+gravat...))
1	4	T ₁₉	-24.6398	Humidity
2	5	T ₁₈	-56.02115	<i>Saturation</i>
1	4	T ₁₉	-24.6398	<i>Humidity</i>
2	4	T ₂₀	-80.66095	Admixture
8	2	T ₇	9.8105	<i>Hope</i>
2	4	T ₁₉	-80.66095	<i>Admixture</i>
6	3	T ₂₁	-70.85045	Brewing

Table B2: Original Latin*Extraction of terms from the O-mesh*

<i>X</i>	<i>Y</i>	<i>A-component</i>	<i>O-component</i>	<i>English term</i>	<i>Fusion</i>
		<i>Pendulum</i>	<i>Destination</i>	<i>Extract</i>	<i>Value</i>
1	1	T ₁ : D → 1	T _{O1}	Dryness	4.4588
3	1	T ₂ : D → 2	T _{O17}	Unfavourable	4.4619
3	2	T ₃ : T _{A2} → T _{A1}	T _{O3}	Dissolution	8.9207
5	1	T ₄ : D → 3	T _{O15}	Gloominess	7.1208
7	1	T ₅ : D → 4	T _{O13}	Disorder	5.8979
8	2	T ₆ : T _{A5} → T _{A4}	T _{O4}	Preservation	13.0187
8	3	T ₇ : T _{A6} → T _{A3}	T _{O5}	Ingestion	21.9394
10	5	T ₈ : D → 5	T _{O8}	Depression	3.0714
8	7	T ₉ : D → 6	T _{O2}	Weakening	4.7822
7	5	T ₁₀ : T _{A9} → T _{A8}	T _{O10}	Healing	7.8536
6	5	T ₁₁ : T _{A10} → T _{A7}	T _{O21}	Brewing	29.793
3	7	T ₁₂ : D → 8	T _{O11}	Prevention	7.5504
3	6	T ₁₃ : T _{A12} → T _{A11}	T _{O11}	Prevention	37.3434
1	6	T ₁₄ : 10 → 11	T _{O6}	Possibility	8.088
3	5	T ₁₅ : T _{A14} → T _{A13}	T _{O13}	Disorder	45.4315
1	4	T ₁₆ : D → 9	T _{O9}	Beneficial	1.8934
3	4	T ₁₇ : T _{A16} → T _{A15}	T _{O15}	Gloominess	47.3249